

REMARKS

The Applicants thank the Examiner for the thorough consideration given the present application. Claims 1-7 are pending. Claims 1-7 are amended. Claims 1 and 4 are independent. The Examiner is respectfully requested to reconsider the rejections in view of the amendments and remarks set forth herein.

Foreign Priority

It is gratefully appreciated that the Examiner has accepted the Applicants' claim for foreign priority.

Information Disclosure Citation

Applicants thank the Examiner for considering the reference supplied with the Information Disclosure Statement filed April 6, 2004, and for providing Applicants with an initialed copy of the PTO-1449 form filed therewith.

Drawings

The Examiner has objected to the drawings because, allegedly, every feature of the invention is not shown in the FIGS. In response, independent claims 1 and 4 are amended, thus addressing the issue pointed out by the Examiner. Withdrawal of this objection is respectfully requested.

In addition, two sheets of revised formal drawings are voluntarily submitted herewith to properly label FIGS. 1(a), (b), 2(a), (b), and 3 as "Background Art".

Substitute Specification

In accordance with MPEP §608.01(q), Applicants herewith submit a substitute specification in the above-identified application. Also included is a marked-up copy of the original specification which shows the portions of the original specification which are being added and deleted. Applicants respectfully submit that the substitute specification includes no new matter and that the substitute specification includes the same changes as are indicated in the marked-up copy of the original specification showing additions and deletions.

Because the number of amendments which are being made to the original specification would render it difficult to consider the case, or to arrange the papers for printing or copying, Applicants have voluntarily submitted this substitute specification. Accordingly, Applicants respectfully request that the substitute specification be entered into the application.

Rejections under 35 U.S.C. §103

Claims 1-7 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Salama (U.S. 6,801,441) in view of Umezu (U.S. 4,656,571). This rejection is respectfully traversed.

A complete discussion of the Examiner's rejection is set forth in the Office Action, and is not being repeated here.

While not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicants respectfully submit that independent

claim 1 has been amended to recite a combination of steps in a method of controlling a voltage controlled PWM frequency converter, including *inter alia*

controlling the inverter bridge so that a curve of filtered average current (I_{dc}) in the DC intermediate circuit substantially follows a curve of a rectified AC supply voltage (U_{dc}).

In addition, independent claim 4 has been amended to recite a combination of elements in a voltage controlled PWM frequency converter, including *inter alia*

wherein the PWM controller unit (14) controls the inverter bridge so that the curve of filtered average current (I_{dc}) in the DC intermediate circuit substantially follows a curve of a rectified AC supply voltage (U_{dc}).

Support for the novel features of claims 1 and 4 can be seen in FIG. 4 (b), in which the curve of filtered average current (I_{dc}) in the DC intermediate circuit substantially follows a curve of a rectified AC supply voltage (U_{dc}).

According to the present invention, the output AC voltage, preferably a three phase output voltage, the amplitude and frequency of which are adjustable, is formed from a single phase AC supply so that the curve form of the intermediate circuit current I_{dc} follows the intermediate circuit voltage U_{dc} wave form so that as a result the curve of the supply network current is sinusoidal.

The idea of the present invention is to achieve a system for forming a three phase output voltage controlling a three phase AC motor from a single phase AC supply, whereby the DC voltage in the intermediate DC circuit varies greatly, i.e., between the peak value and

the approximate zero value, and whereby the input current of the converter should remain as sinusoidal.

Applicants respectfully submit that the combination of steps/elements as set forth in each of independent claims 1 and 4 is not disclosed or made obvious by the prior art of record, including Salama and Umezu.

Prior Art

As indicated in the description of the patent application, page 1, a frequency converter generates an AC output voltage with varying voltage and frequency.

A prior art frequency converter according to page 1 of the description further comprises a rectifier bridge for rectifying an AC voltage of a supply line to a DC voltage for a DC intermediate circuit and an inverter bridge for the inversion of the intermediate circuit DC voltage into a single phase or three phase variable frequency AC voltage. The semiconductor switches in the inverter bridge are controlled with pulse-width modulation by means of a PWM control unit.

Prior art solutions aim at maintaining a constant voltage in the DC intermediate circuit by using a high-capacitance DC intermediate capacitor as an intermediate energy storage. The ratings of the capacitors are generally determined by the capacitors' ability to withstand the electric current ripple and voltage loading applied to them and the required service lifetime. These requirements cause that the DC capacitor components are normally bulky and expensive.

Further, the line current in the supply AC mains in the prior art frequency converters is neither sinusoidal nor in phase with the supply voltage. For this reason, the prior art single phase frequency converters can be provided with an active PFC (Power Correction Factor) circuit in order to make the input current sinusoidal and to compensate the power factor so that the line current will be in phase with the line voltage. However, such PFC circuits make the frequency converter more expensive and complicated.

Cited References

According to our understanding the references cited by the Examiner do not present the present invention as it is defined in claims 1 to 7.

Salama discloses in Fig. 1 a three-phase voltage-controlled PWM frequency converter having an uncontrolled rectifier bridge 10 for the rectification of a three-phase alternating voltage obtained from a supply line to produce a d.c. intermediate circuit d.c. voltage, and a controlled inverter bridge for the inversion of the direct voltage of the d.c. intermediate circuit so as to produce a variable-frequency three-phase alternating voltage consisting of phase voltages. The inverter bridge 11 is a full-wave bridge in which a control unit controls the phase switches of each phase via pulse width modulation. In Salama, the rectifier bridge 10 is connected to the inverter bridge 11 directly without a d.c. capacitor unit acting as an intermediate energy storage and the direct current produced by the inverter bridge flows directly into the supply line without current limitation by an inductor unit.

Thus, Salama discloses a three-phase frequency converter which differs essentially from the present invention, i.e. Salama does not disclose a frequency converter wherein a three-phase inverter bridge would be controlled so that the curve of filtered average current in the DC intermediate circuit would follow essentially the curve of the rectified AC supply voltage, wherein a single phase rectifier bridge would be connected to the inverter bridge directly without a DC capacitor unit acting as an intermediate energy storage, and wherein the curve of the power fed to the load would have essentially the form $\sin^2(2\pi f t)$.

Thus, in Salama, the supply to the converter is a three-phase voltage, not single-phase, and the input current is not discussed. The intermediate DC voltage varies and follows the max supply main voltage and does not reach the zero value, not even near it.

Umezu merely discloses an ordinary single-phase frequency converter wherein the apparatus is provided with an ordinary smoothing capacitor so that the intermediate DC voltage is constant as shown in Figs. 2b and 3b. Umezu does therefore not relate to the present invention in any way. As already described, in conventional PWM frequency converters like in Umezu the intermediate DC voltage is due to a capacitor operating as a energy storage essentially constant, and from this constant voltage is an output AC voltage generated with pulse width modulation, for example three phase voltage, that is as far as possible sinusoidal, the amplitude and frequency of which are freely adjustable.

Umezu does not discuss the supply network current, and the intermediate DC voltage is clearly constant due to the big DC capacitor in the DC intermediate circuit.

Further, the two references cited by the Examiner cannot be combined in a way that would remind of the present invention.

At least for the reasons explained above, the Applicants respectfully submit that the combination of elements as set forth in each of independent claims 1 and 4 is not disclosed or made obvious by the prior art of record, including Salama and Umezu. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

All dependent claims are in condition for allowance due to their dependency from allowable independent claims, or due to the additional novel features set forth therein.

Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. §103(a) are respectfully requested.

CONCLUSION

Since the remaining patents cited by the Examiner have not been utilized to reject claims, but merely to show the state of the art, no comment need be made with respect thereto.

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. It is believed that a full and complete response has been made to the outstanding Office Action, and that the present application is in condition for allowance.

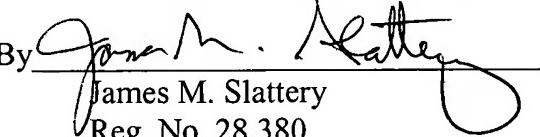
If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, he is invited to telephone Carl T. Thomsen (Reg. No. 50,786) at (703) 205-8000.

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Amendment dated September 15, 2005
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If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§1.16 or 1.17, particularly extension of time fees.

Respectfully submitted,
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Attachment: Substitute Specification
Two sheets of revised formal drawings

*Application No. 10/766,927
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AMENDMENTS TO THE DRAWINGS

Two sheets of revised formal drawings are submitted herewith to properly label FIGS.

1(a), (b), 2(a), (b), and 3 as “Background Art”.